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Nano Calcium Sulfate Coating of Implant Pieces

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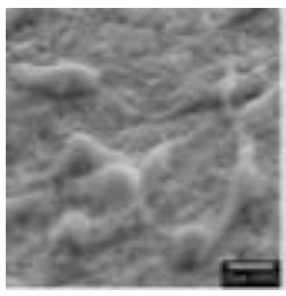
ABSTRACT

Objectives:
The goal of this research is to test the effects of a novel nano calcium sulfate (nCS) scaffold on osseointergration of a SLA-Active titanium plates and collagen plug pieces. nCS, formulated and patented by Dr. Dziak's lab has been shown to increase osteoblastic cell growth and differentiation. The titanium plates represent the material most commonly used in dental implants and the collagen pieces are often placed at the implant site to facilitate wound healing that occurs after the implant placement.
Results:
There was a significant increase in osteoblastic cellular viability/ proliferation measured with the MTT assay in cells cultured on the plates and collagen plugs coated with nCS.
Conclusions:
The nCS coating was shown to increase the proliferation of osteoblastic cells growing on the titanium surface as well as that of collagen plugs. Our results suggest that a scaffold coating of nCS can support bone formation at sites of implants and lead to increased osseointegration. These data have positive clinical implications for the use of nanocalcium sulfate with implant materials to increase bone regeneration at sites of implant placement.

INTRODUCTION

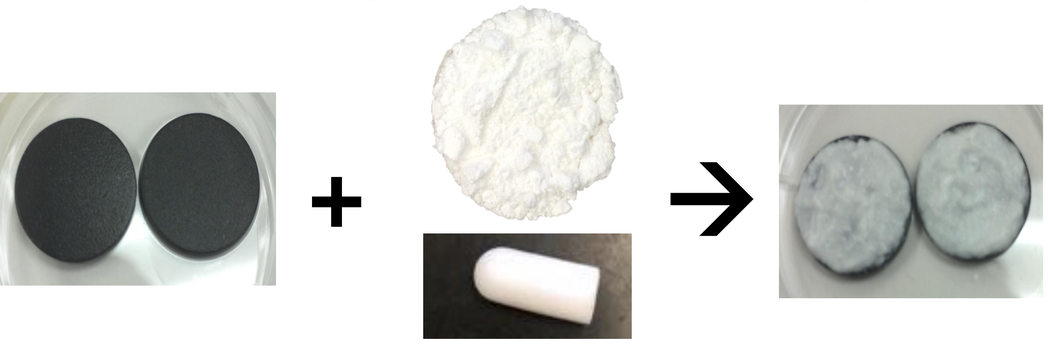
Calcium Sulfate (CS) has been successfully used in its hemihydrate form in medicine for bone grafting material. Calcium sulfate is utilized as an osteoconductive scaffold that increases bone regeneration while maintaining space and preventing soft tissue invasion. Most recently the Dziak lab in the Department of Oral Biology at UB has been involved in the fabrication of a novel nanocalcium sulfate (ncs) material that has enhanced properties, due to the nanosized particles, for attachment and increased osteoblastic cell proliferation, and further growth.
Dental implants are made of titanium alloys due to its benefit in osseointegration with human osteoblastic cells. Osseointegration is achieved when there is direct bone to implant contact and the implant can be loaded without movement. Implant surface and biocompatibility are major components in the implant success which is measured by its osseointegration. SLA active implants have shown to have the most rapid osseointegration which is why they have become the industry standard. There is great need for the accelerated healing of implants in dentistry, and one solution that has previously been suggested is the coating of implants with CS due to its advanced abilities in formation of new bone. We hypothesize here that coating with ncs will lead to further enhancement of osteoblastic cell growth characteristics.



Cells attached to nCS

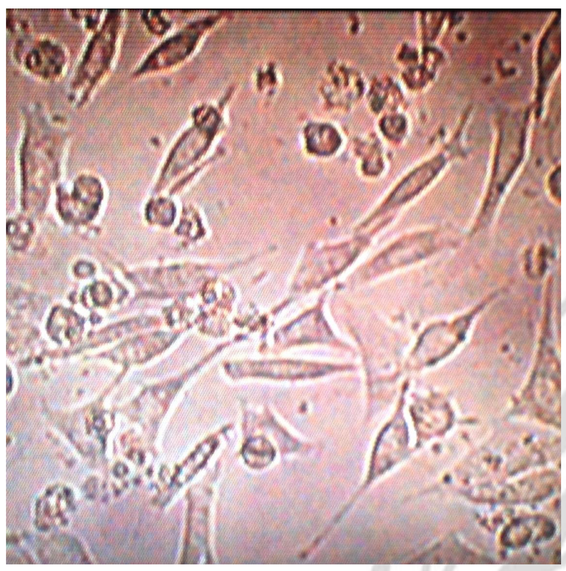
MATERIALS and METHODS

Titanium SLA active plates were coated with 75ug of nCS



- Titanium plates were donated from STRAUMANN
- Plates are SLA- Active
- Sterilized via Autoclave and Glow Discharge

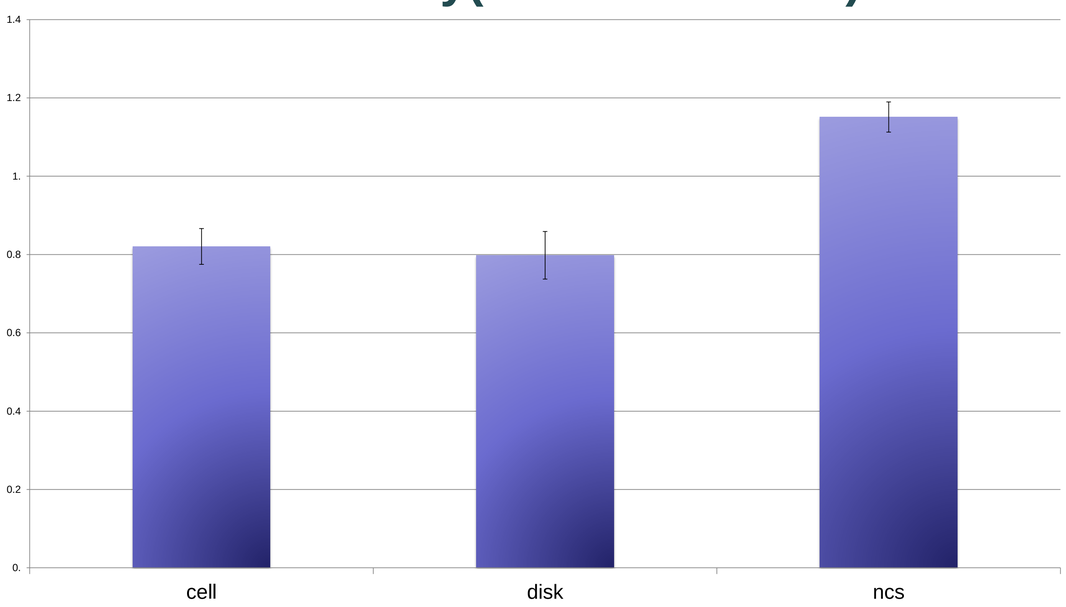
- A solution made of 2000mg/L calcium sulfate
- Formulated into nCS using a cyro-vacuum



- Primary cultures of human osteoblastic cells were obtained from a commercial supplier (ScienCell)
- Osteoblastic cells at a concentrations of 50,000/mL were seeded on uniform pieces of materials with and without nCS coating
- Cells were incubated at 37 for 48 hours in tissue culture wells
- Cells were lysed, MTT assays which measure mitochondrial activity as an indicator of cell viability were conducted

RESULTS

MTT Assay(Titanium Plates)



MTT Assay (Collagen Plugs)